PHYSICO-MECHANICAL INVESTIGATIONS ON DIFFERENT WINTER WHEAT VARIETIES

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SUMMARY

The kernel hardness is a significant characteristic. Wheat kernel hardness determines quality, flour yield, flour particle-size, water absorption and other quality characteristics of cereals. The final classification for wheat is kernel hardness.
The aim of our research was to determine the kernel hardness with new static methods. To the static methods we used the Lloyd 1000 R Testing Machines. We determined the kernel hardness with the well-known and recognized method also. It was the Perten Single Kernel Characterization System (SKCS) 4100 device.
Registered and widely used Hungarian wheat varieties were applied in the study. It was 11 different winter wheat varieties (7 of HRWW and 4 of SRWW). The samples were labelled with code number. Our aim was to compare these methods.

1. INTRODUCTION

Kernel hardness is an important measurable attribute of wheat that has been correlated to it's chemical and genetic make-up. The evaluation of wheat kernel hardness has been used in predictions of flour yield and gives early indication of baking performance (Pomeranz and Williams, 1990). Factors influencing kernel hardness include variety and environment, however the total variation in hardness has yet to be explained.
Kernel hardness controlls by friabilin protein and it depends on the relation between protein matrix and starch granules. The friabilin presents in high concentration in soft grain varieties and low concentration in hard grain varieties. The flour which is made from hard winter wheat varieties are better than the flour which is made from soft winter wheat varieties. Such indicators are flour yield and flour particle size since the adhesion between the starch granules and proteins of hard varieties is so strong in the milling process that starch granules fragment rather than get released from the protein matrix as they do in soft wheat varieties. This will have the greatest effect on the resulting flour's baking properties. Hard wheat flours have a medium to high protein content and stronger gluten-forming proteins than soft wheat. Consequently, hard wheat flours tend to be ideally suited for yeast-raised products that depend on gluten strength to retain leavening gasses. Soft wheat flours are lower in protein and gluten strength and are more commonly found in pastries and chemically leavened products (Evers et al. 2002).

2. MATERIALS AND METHODS

The aim of this research was the investigation of winter wheat varieties. We investigated the kernel hardness in wheat varieties widely used in the Hungarian agriculture.

Materials

11 entries (registered wheat varieties) of bread with diverse technological qualities were used in this study (7 of HRWW and 4 of SRWW). The entries produced in the year of 2006 in Szeged, Hungary and were evaluated for various quality characteristics.

Methods

The Perten SKCS 4100 instrument is one of the well know machines, which examine the kernel hardness. This device measures kernel texture by crushing the kernels one at a time, recording the force required to crush the kernel, and reporting the average force for crushing 300 kernels, in terms of a hardness index (HI) (Martin et al. 1993)

Figure 1. Perten SKCS 4100 instrument

We determined the maximum breaking force, the break work, the deformation modulus with the LLOYD 1000 R Material Testing Machines. We examined the grain in vertical position. To the vertical position: we scraped the grain, the surface on the side of the beard and the germ and this machine presses the kernels with the compressor head of Lloyd 1000 R testing machine of 1000 N force, and by reading the force – displacement curve. From this graph we read the breaking force, and calculate the deformation modulus and the break work. This method is a new invention (Szabó et al 2006).

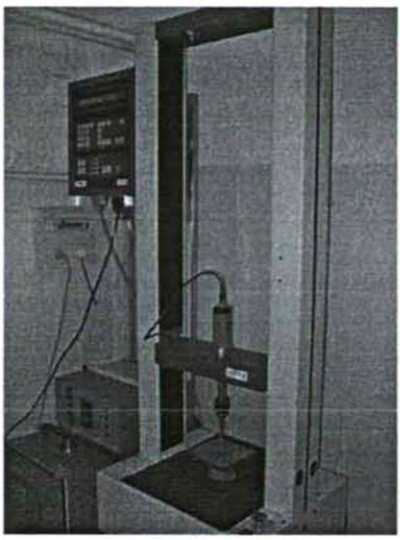

Figure 2. Lloyd 1000 R testing machines

3. RESULTS

The deformation modulus (E), the breaking force (F_t) and the break work (W_t) were determined by the penetrometer (Lloyd Instrument). The Hardness Index was determined by SKCS device.
In our previous research we examined the samples with different moisture content. Our hypothesis was that the moisture content is a very important behavior of the samples. Now, the moisture content of the entries were 13,52 %. It is a good moisture parameter to the safety storage.
Average of 30 kernel of the deformation modulus, breaking force, break work show one point in the diagram.
Figure 3 shows the connection between the deformation modulus and Hardness Index.

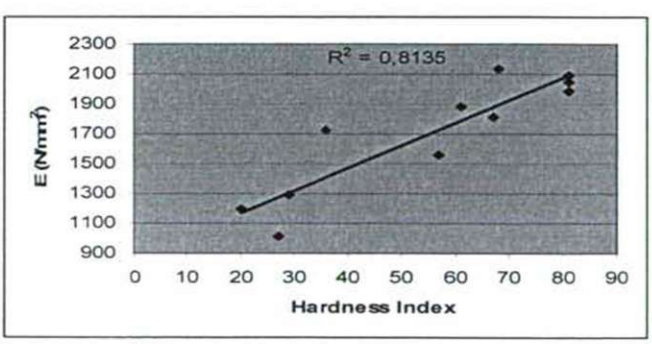

Figure 3. Connection between the deformation modulus and Hardness Index

The equation:

$$E = 15{,}038 * HI + 871{,}91 \ (\mathbf{R^2=0{,}813})$$

E: Deformation modulus (N/mm^2)
HI: Hardness Index

Figure 4 shows the breaking force and Hardness Index connection.

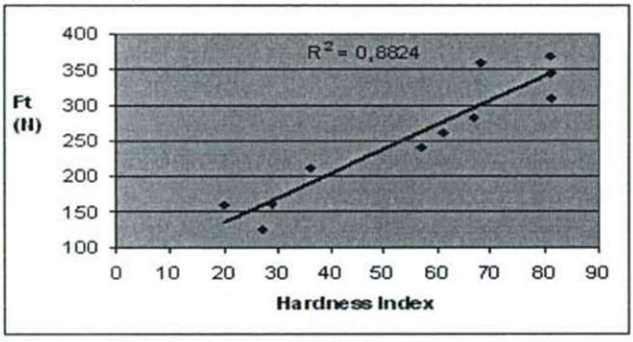

Figure 4. Breaking force and Hardness Index connection

The connection between the breaking force and the Hardness Index is strong. The equation:

$$\text{Breaking force} = 3{,}4192 * HI + 67{,}272 \ (\mathbf{R^2=0{,}882})$$

HI: Hardness Index

Figure 5 shows the break work and Hardness Index connection.

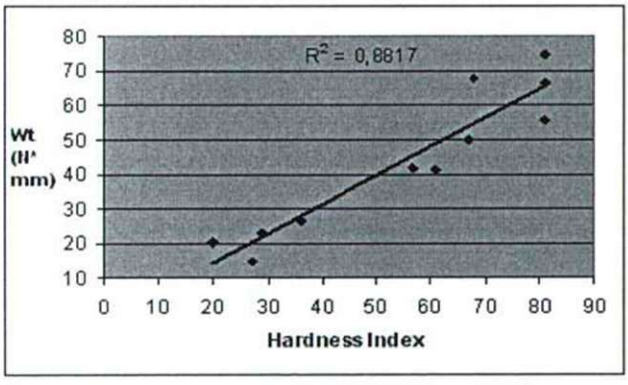

Figure 5. Break work and Hardness Index connection

There is a strong correlation between the break work and the Hardness Index:

$$\text{Break work} = 0{,}8403 * HI - 2{,}5049 \ (\mathbf{R^2=0{,}882})$$

HI: Hardness Index

The average of the deformation modulus was: 1304,77 N/mm^2 – soft wheat varieties;1930,76 N/mm^2– hard wheat varieties. The average of the breaking force was:

164,34 N – soft wheat varieties; 308,78 N – hard wheat varieties. The break work: the average was 21,34 N/mm – soft wheat varieties; 56,85 N/mm – hard wheat varieties.
We found strong correlation between the Hardness Index and the mechanical properties (deformation modulus, breaking force, break work), when the moisture content was 13,5%.

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